REMARKS

In the Office Action ("OA"), the Examiner rejected claims 1, 2, 13, 15, 23, and 24 under 35 U.S.C. § 103(a) as unpatentable over Chen et al., U.S. Patent No. 6,350,667 ("*Chen*") in combination with Ding et al., U.S. Patent No. 6,057,237 ("*Ding*"), and Cabral, Jr. et al., U.S. Publication No. 2002/0046874 ("*Cabral*"), and rejected claims 16-22 and 25-27 under 35 U.S.C. § 103(a) as obvious over *Chen* in combination with *Ding* and Galloway, U.S. Patent No. 5,783,868 ("*Galloway*"). Applicants traverse these rejections for the reasons set forth below.

I. Response to Rejection Under 35 U.S.C. § 103(a) Over *Chen*, *Ding*, and *Cabral*

The Examiner rejected claims 1, 2, 13, 15, 23, and 24 under section 103(a) as unpatentable over *Chen* in combination with *Ding* and *Cabral*. In response, Applicants submit that a *prima facie* case of obviousness has not been established for these claims because Chen, Ding, and Cabral, taken alone or in combination, fail to teach or suggest all the elements of these claims.

In order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim elements. Furthermore, "[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art." M.P.E.P. § 2143.03, ed. 8, rev. 1 (Feb. 2003) (quoting *In re Wilson*, 424 F.2d 1382, 1385 (C.C.P.A. 1970)). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. Third, there must be a reasonable expectation of success. M.P.E.P. § 2143 at 2100-122 to 127.

Claim 1 is directed to semiconductor device comprising a combination of elements including, *inter alia*, "an intermediate layer formed at least on [a] Cu film, the intermediate layer

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comprising a TaN film formed on the Cu film and a Ta film formed on the TaN film, wherein a thickness of the TaN film is 20 nm or more."

Chen is directed to a semiconductor device which includes a thin adhesion layer of aluminum between a metal wiring and an intermediate layer. *Chen*, Fig. 4. The Examiner alleged that *Chen* discloses that the intermediate layer comprises a TaN film formed on the Cu film and a Ta film formed on the TaN film. (OA at ¶ 2.) Contrary to the Examiner's allegation, *Chen* does not disclose an intermediate layer which includes Ta film formed on a TaN film. Specifically, *Chen* discloses that a TaN intermediate layer is formed on a thin Al layer. However, *Chen* does not disclose that a Ta layer is formed on the TaN layer. *Chen*, col. 7, ll. 1-10. Thus, *Chen* fails to teach or suggest at least "an intermediate layer formed at least on [a] Cu film, the intermediate layer comprising a TaN film formed on the Cu film and a Ta film formed on the TaN film, wherein a thickness of the TaN film is 20 nm or more," as recited in claim 1.

The Examiner also alleged that *Ding* discloses a Ta film formed on a TaN film and alleged that *Cabral* discloses a Ta film formed on TaN. (OA at ¶ 3-4.) However, neither *Ding* nor *Cabral* teaches or suggests that a thickness of the TaN film is 20 nm or more.

Ding discloses that the tantalum barrier layer can be composed of alternating tantalum and tantalum nitride layers. *Ding*, col. 2, ll. 40-53. However, *Ding* discloses that the thickness of the TaN layers are each formed to a thickness of 5 nm. *Ding*, Fig. 3. Thus, *Ding* fails to teach or suggest at least "an intermediate layer formed at least on [a] Cu film, the intermediate layer comprising a TaN film formed on the Cu film and a Ta film formed on the TaN film, wherein a thickness of the TaN film is 20 nm or more," as recited in claim 1.

Cabral is directed to a thin film liner for electrical interconnections. *Cabral* discloses that liner 23 can be formed of a TaN layer and a second layer of Ta. Cabral, ¶ 36. Further,

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Cabral discloses that the grain size, when viewed from above, is approximately 20-30 nm, but *Cabral* does not disclose the thickness of the TaN layer. *Cabral*, ¶ 45-46. Thus, *Cabral* fails to teach or suggest at least "an intermediate layer formed at least on [a] Cu film, the intermediate layer comprising a TaN film formed on the Cu film and a Ta film formed on the TaN film, wherein a thickness of the TaN film is 20 nm or more," as recited in claim 1.

Thus, since *Chen*, *Ding*, and *Cabral*, alone fail to teach or suggest at least "an intermediate layer formed at least on [a] Cu film, the intermediate layer comprising a TaN film formed on the Cu film and a Ta film formed on the TaN film, wherein a thickness of the TaN film is 20 nm or more," *Chen*, *Ding*, and *Cabral*, when taken together, fail to teach or suggest all the elements of claim 1. For at least this reason, claim 1 is allowable.

Claims 2, 13, 15, 23, and 24 are allowable at least due to their dependence from allowable claim 1. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." M.P.E.P. § 2143.03 at 2100-126 (citing *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)).

The Examiner also alleged, with regard to the claim recitations of a thickness of the TaN film being 20 nm or more (claim 1) and a thickness of the Ta film being 5 nm or less (claim 13), that "it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical." (OA at ¶ 6.)

Contrary to the Examiner's allegation, Applicants submit that the thickness of the TaN film and Ta film as claimed is not an obvious matter of design choice that would be ascertainable

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by routine experimentation. The specification discloses advantages, discovered by Applicants, of using a thickness of the films in the claimed ranges. More particularly, Fig. 4 illustrates an embodiment of the invention showing the reduction in sheet resistance when the thickness of the TaN film is formed at 20 nm or more. (See also, Specification at 15.) Furthermore, the Specification at page 15 describes the advantages of a thickness of the Ta film being 5 nm or less. Thus, Applicants submit that the thickness of the TaN film and the Ta film are not an obvious matter of design choice.

Moreover, one skilled in the art would not have been motivated to modify the thickness of the films disclosed in the cited references as an obvious matter of design choice. More particularly, none of the cited references, *Chen*, *Ding*, or *Cabral*, suggests modifying the thickness of the films. For example, *Ding* discloses that the thickness of the TaN layers are each formed to a thickness of 5 nm to obtain certain results. *See Ding*, col. 2, l. 54 to col. 3, l. 3. Thus, one skilled in the art would not have been motivated to modify the thickness of the films disclosed in the cited references.

II. Response to Rejection Under 35 U.S.C. § 103(a) Over *Chen*, *Ding*, and *Galloway*

The Examiner rejected claims 16-22 and 25-27 under section 103(a) as obvious over *Chen* in combination with *Ding* and *Galloway*. In response, Applicants respectfully submit that a *prima facie* case of obviousness has not been established for claims 16-22 and 25-27 because *Chen*, *Ding*, and *Galloway*, taken alone or in combination, fail to teach or suggest all the elements of these claims.

Claim 16 is directed to a semiconductor device comprising a combination of elements including, *inter alia*, "an Al film formed on [a] Ta film and used as a pad, the Al film having a horizontally extending portion under which [a] Cu film is not formed; and a conductive connection member connected to the Al film at the horizontally extending portion."

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The Examiner alleged that *Chen* and *Ding* disclose an Al film having a horizontally extending portion under which the Cu film is not formed. (OA at ¶ 8.) Further, the Examiner admitted that *Chen* and *Ding* do not disclose that a conductive member is connected to the Al film at the horizontally extending portions. (OA at ¶ 9.) Yet, the Examiner alleged that *Galloway* discloses a conductive connection 12 is connected at an extending portion. (OA at ¶ 10.) Applicants respectfully submit that the Examiner has misconstrued *Galloway*.

Galloway discloses a semiconductor device including a metal layer 12 having an extension area 12a connected to an original wire bond pad 16 and a metal bump 24 connected to metal layer 12 above wire bond pad 16. *Galloway*, Fig. 5. *Galloway* further discloses that, in burn-in testing, a wire bond 92 is connected to extension area 12a, to thereby prevent pad 16 from being damaged due to the connection of wire bond 92. *Galloway*, col. 4, line 47, to col. 5, line 5. However, in *Galloway*, the conductive connection member is a metal bump 24 connected to the metal layer 12 which is above wire bond pad 16, not wire bond 92. In fact, wire bond 92 is removed after burn-in testing. Thus, *Galloway* fails to teach or suggest at least "a conductive connection member connected to the Al film at the horizontally extending portion" as recited in claim 16.

Therefore, since *Galloway* does not cure the deficiencies of *Chen* and *Ding*, *Chen*, *Ding*, and *Galloway*, fail to teach or suggest at least "an Al film formed on [a] Ta film and used as a pad, the Al film having a horizontally extending portion under which [a] Cu film is not formed; and a conductive connection member connected to the Al film at the horizontally extending portion," as recited in claim 16.

Moreover, even if *Galloway* could properly be combined with *Chen* and *Ding* (which Applicants do not concede), the combination would still not render the claimed invention

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obvious. As mentioned above, in *Galloway*, the conductive connection member is a metal bump 24 connected to the metal layer 12 which is above wire bond pad 16, not wire bond 92. Thus, if the connection member of *Galloway* were to be combined with *Chen* as alleged by the Examiner, the resultant structure would be a metal bump 24 from *Galloway* formed directly over copper layer 3 in *Chen*. *See Galloway*, Fig. 1 and *Chen*, 3. Attached Exhibit A illustrates what the Examiner's hypothetical combination of *Galloway* with Fig. 3 of *Chen* would look like.

Therefore, *Chen*, *Ding*, and *Galloway*, when taken alone or in combination, fail to teach or suggest at least "an Al film formed on [a] Ta film and used as a pad, the Al film having a horizontally extending portion under which [a] Cu film is not formed; and a conductive connection member connected to the Al film at the horizontally extending portion," as recited in claim 16. Accordingly, a *prima facie* case of obviousness has not been established for claim 16. For at least this reason, claim 16 is allowable.

Claims 17-22 and 25-27 are allowable at least due to their dependence from allowable claim 16. M.P.E.P. § 2143.03 at p. 2100-126.

III. Conclusion

In view of the foregoing, Applicants respectfully request reconsideration and reexamination of this application and the timely allowance of the pending claims.

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Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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EXHIBIT A